Catalysts for the Oxidation of Trace Contaminants

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As human exploration of space requires missions of longer duration, spacecraft trace contaminant control systems with improved logistics and power requirements must be developed. Central to this need is the development of a new oxidation catalyst that exhibits improved activity and poisoning resistance combined with the ability to effectively control a large spectrum of trace chemical contaminants observed in spacecraft cabin atmospheres. Of special importance is the controlling of hydrocarbons in the presence of known catalyst poisons such as chlorocarbons, chlorofluorocarbons, and sulfides.

The primary objectives of the project are to develop a suitable co-precipitated metal/metal-oxide catalyst, investigate the effects of various dopants on its capabilities to oxidize trace hydrocarbons at high temperatures and carbon monoxide at room temperature, characterize its activity and poisoning characteristics, develop repeatable processing and fabrication techniques, and deliver a catalyst on a support suitable for use in the design and development testing of future spacecraft contamination control systems.

Initial work on co-precipitated gold/cobalt-oxide catalysts during phase I of the project produced catalysts which had methane oxidation activity comparable to the best commercially available platinum- and palladium-based catalysts. This catalyst also exhibited very high activity for carbon monoxide oxidation at temperatures as low as –70 °C. However, the phase II work demonstrated that the high-temperature catalyst was strongly poisoned by sulfur compounds and was only moderately stable at high temperatures. Phase II work also resulted in the development of an oxide catalyst that exhibits higher room temperature carbon monoxide oxidation activity than any commercially available catalyst. The use of this catalyst can dramatically lower the power requirements for catalytic oxidation because carbon monoxide's high generation rates from offgassing and crew metabolism and high toxicity make it the contaminant which sets the flow rate through the catalytic oxidation system. If the carbon monoxide can be oxidized at room temperature, the flow rate and power requirements of the catalytic oxidizer can be greatly reduced.

Opportunities are now being pursued to commercialize the newly developed catalyst. Applications include removal of carbon monoxide from closed environments, automotive cold-start emissions control and negative emissions vehicles, portable carbon monoxide sensors, and closed-cycle carbon dioxide lasers.

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